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An Innovative Pipeline Risk Mitigation Consultancy

- TRIAGE integrity hazard classification & mitigation guidance

The Transformation of Upstream to Performance-Based (SLMS) Pipeline Integrity Management Arrives with Perfect Timing

Executive Summary

Governments, regulators, the public and industry have indicated that improved pipeline performance within the upstream and mid-stream gathering infrastructure is essential. Industry leaders can achieve a higher level of performance through adoption of available and emerging methods and technologies, and by implementing them as the foundation of a formal performance-based (SLMS) asset management model.

A sustainable pathway to recover and sustain the growth of the oil and gas production sector will be aided by the adoption of long-term strategic asset management (SLMS) plans for managing pipeline integrity (gathering and mid-stream) that seamlessly align with the objectives of regulations to achieve and sustain satisfactory pipeline safety. Adoption of a quality management model has the potential to more effectively address underlying causes of pipeline failures compared with the prevailing "compliance-is-enough" approach; an initiative of critical importance because recovery of the industry will otherwise bring along with it an elevated vulnerability to pipeline failures.

Within the article, we advocate for our proven TRIAGE service; a proven pipeline integrity hazard classification and mitigation planning tool. Because TRIAGE has uniquely identified and addressed previous integrity hazard blind-spots, its adoption will improve operational and financial performance, reduce future pipeline failure events, and influence a positive reversal of public perception towards our industry when implemented within a quality SLMS management model.

Averting a Future "Bump" in Pipeline Failure Frequency

Many industries go through critical milestone moments by which their future success or failure are determined. The oil and gas industry are currently at a point where the status quo and short-term "compliance-is-enough" perspective on managing pipeline safety will not be enough to address an inevitable escalation in the complexity and severity of integrity hazards associated with future recovery of the industry.

For the most part, there is a shared understanding of the underlying issues contributing to pipeline failures, and that, despite a linear decline in annual failure count since 2008, key underlying factors contributing to pipeline failures have not been resolved.

It is noteworthy that oil and gas companies in western Canada are at present utilizing production gathering pipeline infrastructure equivalent to 1988 levels (based upon a comparison of total pipeline length in active "operating" status), and that 160,000 km of pipelines active as of end-2007 are presently suspended; a level of proportional well and pipeline shut-in status never before experienced in the history of Canadian oil and gas industry.

The implication of an unprecedented aggregate of shut-in assets will inevitably lead to a future level of re-activation activity expected to expose the industry to a nearly immediate and unprecedented level of pipeline failures attributed (in particular) to internal corrosion if the causal factors are not addressed. A forecasted increase in pipeline failures is based upon the findings of complex data pattern analytics applied onto 40-years of industry data sources. Such an exercise recently uncovered a previously over-looked (yet dominant) pipeline integrity threat associated with exposure to accelerated corrosion damage coincident with re-activation of a sub-set of producing well(s).

Data patterns associated with historical pipeline failures position the industry to irrefutably pin-point specific wells within sub-geographic operating regions most vulnerable to; 1) the formation of in-situ downhole corrosive biomass sludge (incubated at time of drilling operations); and, 2) short-term (high-shear) production surges at the time of well start-up capable of transporting (up-lifting) the corrosive biomass sludges into the downstream connected pipeline network(s). These two factors contribute to the onset of a previously overlooked integrity "blind-spot" hazards; identified (in hindsight) as a dominant contributor to most historical pipeline failure events.

Figure 1.0 – Evidence of Accelerated Corrosion Damage Attributed to Fugitive Biomass Sludge

The correlation between detrimental upstream well behaviour at start-up and accelerated corrosion damage occurs for approximately 80% of all historical pipeline failures; 11,500 of 14,000 pipeline failure events (1978 – 2019). In addition, both corrosion pitting morphology (not typical of normal reservoir fluids) and rapid time-to-failure (typically 30 – 200 days following high-shear-stress well start-up events) are consistent with the suggestion that most pipeline corrosion failures (within specific operating regions) have been influenced by the episodic ingress of a fugitive fluid capable of causing unexpectedly rapid corrosion.

It is encouraging that the industry is working to position themselves to better address underlying causal issues, and to avoid an otherwise inevitable "bump" in future pipeline failure events by continuing on their transformative path towards a performance-based (SLMS) integrity management model, and away from a traditional "compliance-is-enough" strategy.

SLMS Shifts Accountability for Pipeline Safety to the Operator

We support the activities of production, mid-stream and product transportation companies to embrace a profound shift in governance and operating philosophy towards a performance-based ("owner-user") integrity and reliability management (SLMS) model, and we are supportive of the important work of both the regulators and industry as they work together to provide an organized, tiered and logical transition plan.

A quality SLMS framework for disciplined management is necessary to address complex integrity deterioration mechanisms, and to achieve needed safety and reliability performance on behalf of industry stakeholders. A successful SLMS model permeates everything an operator does to ensure safety within their operational work processes by providing specific performance goals and objectives from which compliance and performance can be measured, evaluated and improved.

A comparative summary of the prevailing (under-performing) "compliance-is-enough" prescriptive model demonstrates how improved future outcomes can be best achieved by industry-wide adoption of a performance-based (SLMS) model for managing pipeline integrity.

Comparison of a performance-based (SLMS) model versus a traditional time-based, prescriptive model:

a. REGULATORY PRESCRIPTIVE INTEGRITY MANAGEMENT - PROS

- Effective in addressing straightforward threats / risks that are well-defined and mitigated with a commonly accepted approach amongst majority of operators (i.e. ground disturbance requirements);
- Relatively easy to plan and implement, high certainty in implementation from cost, schedule and quality perspective; and,
- Highly visible with assured compliance-to-schedules once approach is implemented.

b. REGULATORY PRESCRIPTIVE INTEGRITY MANAGEMENT - CONS

- Many threats and risks associated with upstream well production vary significantly amongst pipeline systems which are not well mitigated by carte blanche measures;
- Compliance does not adequately assess and manage risk, resulting in an ineffective deployment of resources, over-spend on low risks, under-spend on high risks; and,
- Dilution of resources creates "risk-blindness" where key integrity threats are over-looked.

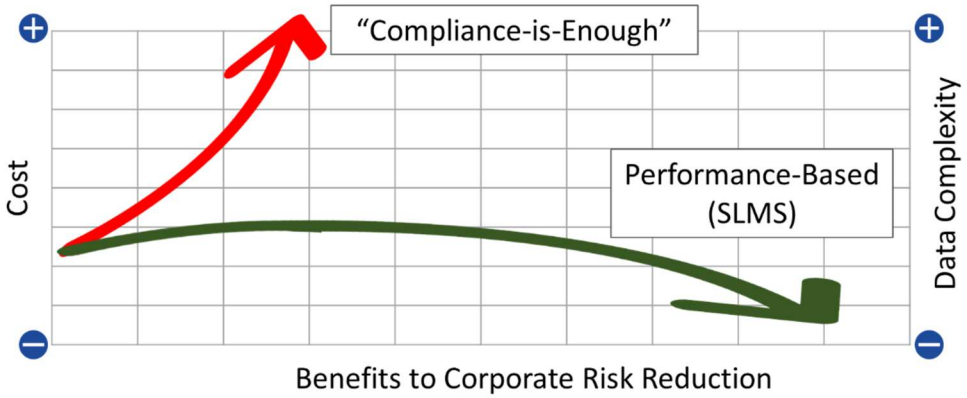
c. PERFOMANCE-BASED (SLMS) INTEGRITY MANAGEMENT - PROS

- Encourages innovation by defining expectations for outcomes, and not prescriptive pathways for task execution;
- Yields flexibility in designing and implementing more effective and efficient pipeline maintenance through engineering measures that reduce contributing factors that lead to pipeline failures; and,
- Prioritizes deployment of resources to mitigate key threats and risks.

d. PERFORMANCE-BASED (SLMS) INTEGRITY MANAGEMENT - CONS

- Harder to define compliance, as activities are likely to be different for every pipeline system; and,
- Requires integration of specialized engineering and risk management expertise, for which there is a shortage within industry, regulators and public.

Figure 2.0 – Benefits of Performance-Based (SLMS) Pipeline Integrity Management



- Enhanced corporate risk reduction;
- Decreased data complexity to support integrity management processes; and,
- 20 – 45% lower cost.

Addressing Former "Risk-Blindness" Proves Beneficial

Progressive integrity management teams adopting a performance-based SLMS model will be most effective if they have easy and affordable access to a service that provides a reliable risk classification (by considering a former "blind-spot" integrity hazard), and which provides appropriate guidance from which field, operations teams can consider their system knowledge and operating experience to create mitigation schedules correctly aligned with actual pipeline condition, and corrosive conditions.

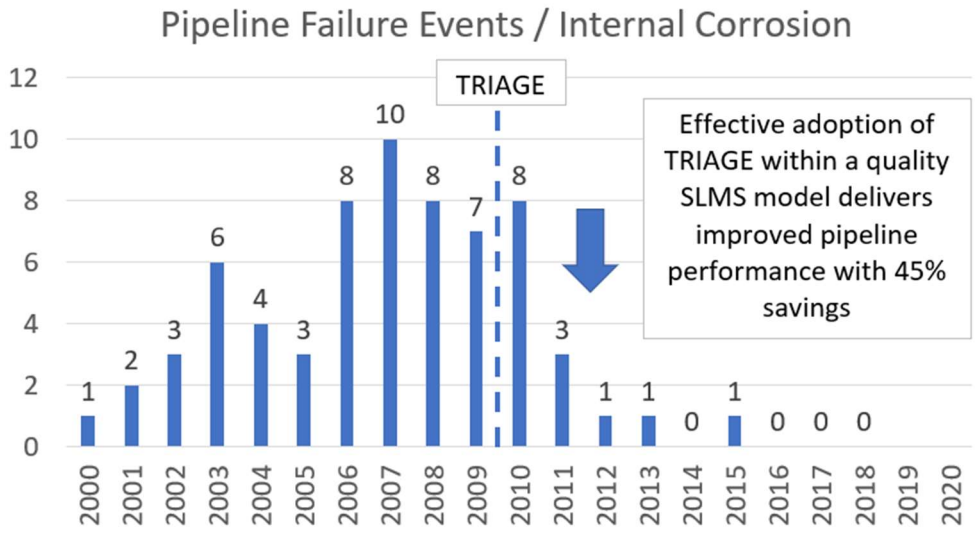
The TRIAGE hazard assessment algorithms developed by www.trustedpipelineadvisor.com has proven successful at addressing the two key causal factors contributing to pipeline failure events, regardless of their operating category; 1) an insufficient characterization of the over-life corrosive environment to which the pipelines have been exposed; and, 2) misalignment between applied mitigation activities and the corrosive conditions within most vulnerable pipelines.

By adopting an over-life "systems" approach, we successfully identified a previously overlooked "blind-spot" integrity hazard associated with well start-up events (for an identified sub-set of production wells); a critical integrity threat attributed to downhole incubation and subsequent up-lift of a fugitive (and highly corrosive) "biomass sludge" not otherwise considered by existing industry standard methods.

Secondly, because of our comprehensive use of historical data patterns to consider the implications of over-life integrity hazards, our TRIAGE method irrefutably classifies pipelines according to the likelihood they will exhibit pre-existing corrosion damage as an outcome of; 1) over-life exposure to normally-produced steady-state fluids; and, 2) episodic ingress of corrosive fugitive fluids associated with detrimental well start-up events; and, 3) non-conforming product shipments caused by upstream process facility operational upsets.

By considering TRIAGE results, field, operations teams can apply their system knowledge and operating experience to better align mitigative activities appropriate to either; 1) stop pre-existing corrosion damage from growing to failure; or, 2) prevent corrosion initiation within previously un-damaged pipelines.

Figure 3.0 – TRIAGE Delivers Proven Results within a Formal SLMS Model



By demonstration of actual results achieved, our TRIAGE integrity hazard assessment and mitigation guidance service has established itself as the most complete, and most reliable integrity hazard classification method compared to all other traditional industry methods being applied onto oil and gas gathering, and midstream transportation pipeline systems when integrated into an effective performance-based (SLMS) management model.

Suggestions for Moving Forward

We consider this to be a "we are in this together" situation; as an innovative subject-matter expert in collaboration with regulatory overseers and owner companies. By working together to resolve persistent causal factors that continue to contribute to pipeline failure events, we can improve pipeline performance, and contribute to sustainable growth of our industry.

We look forward to new opportunities to work on successful projects that complement the work of existing integrity and field, operations teams. Consider contacting us to discuss ideas for how our work can benefit your company.

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